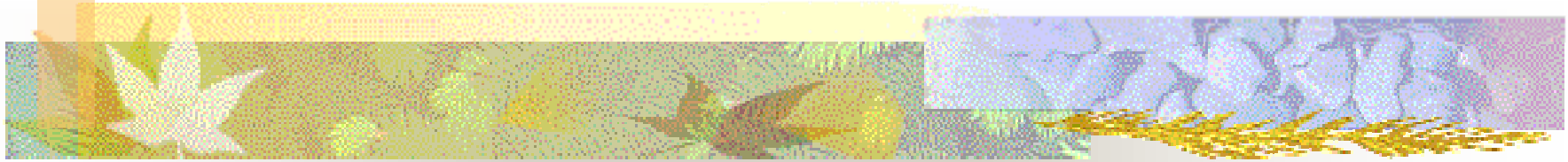
Troubleshooting ICD



NASPE Training

Lancashire & South Cumbria Cardiac Network

- Bradycardia Pacing by ICD
- Isolated ICD discharge
- Multiple discharges
  - Appropriate
  - Inappropriate
- No ICD Therapy or delay in ICD therapy
- Diagnosis arrhythmia type

Brady pacing by ICD

- Should be same as brady pacemaker but inherent differences exist
- Oversensing of all types– may be difficult to correct (high sensitivities and short blanking periods)
- Device – device interaction – undersensing of arrhythmia

Isolated ICD discharges

- 60 – 80% patients receive shock within 1st five years of implant
- Shocks preceeded by syncope/presyncope are almost always appropriate
- Phantom shocks – mostly at night (anxiety, dream state or hypnagogig contractures)

Multiple discharges

- Appropriate
  - Incessant VT – drugs, metabolic state, MI etc
  - VT storm - spontaneous
  - Failed to terminate
  - Shocks due to VT or SVT (Could be classed as appropriate for SVT particularly if a high rate)
- Inappropriate
  - Tends to exist with minimal symptoms

Multiple discharges – minimal symptoms

- Ventricular arrhythmias
  - Haemodynamically tolerated/slow VT
    - Appropriate or innapropriate????
    - Difficult to treat (drugs, ensure ATP 57-95% Success terminating monomorphic VT)
  - Very rapid detection + termination VT/VF
  - Non-sustained VT with committed device (older devices)
- Supraventricular arrhythmias
  - Sinus tachycardia, AF, AFL, AT, SVT
  - Most common - AF

Multiple discharges – minimal symptoms

- Device malfunction
  - Algorhythm error – incorrect interpretation
  - Oversensing – P/T waves, myopotentials
  - Oversensing - electromagnetic interferance (noise seen on all EGM's)
  - Device-device interaction
  - Mechanical system failure – lead fracture, insulation break, loose connector, (noise seen on one EGM), lead displacement (EGM's – same A & V)

Causes of recurrent VT

- Progressive heart disease, LV dysfunction
- Thyroid dysfunction (amiodarone)
- Electrolyte disturbances (illness, infection, GI disturbance, diuretic medication)

Cause absence/delay ICD therapy

- Inactivated ICD
  - Programmed OFF, sustained exposure to magnet
- Undersensing of Ventricular EGM
  - Reduction amplitude EGM, Postshock EGM diminuation, EGM amplitude fluctuation, lead malfunction/displacement, generator malfunction, device-device interaction

Cause absence/delay ICD therapy

- Underdetection
  - VT below cut off rate, VT therapy withheld (onset/stability/wavelet/SVT/algorithm error), detect in wrong zone
- Mechanical failure
  - Lead fracture, poor lead/header connection
- Ineffective delivered therapy
  - Pacing/DFT increase

Ineffective ATP

- Increase pacing thresholds – unable to penetrate re-entry tachycardia
  - Lead position
  - MI/Ischeamia
  - Medication change
- New arrhythmia (new rates and substrate)

Causes of Failed Defib shocks

- Device related
  - Battery depletion
  - Component failure
  - Patch crinkle/crumple
  - Dislodgement of transvenous lead

Causes of failed Defib shocks

- Medical/clinical
  - Evolution DFT over time (especially if 15J + at implant)
  - Pneumothorax
  - MI/active ischeamia
  - Drug prorhythmia/drug affecting DFT
  - Electrolyte abnormalities

Diagnosis of arrhythmia type

- EGM
  - identify (A) or (V) gram
  - Identify near or far field
  - Compare previous EGM’s from previous events
  - Compare EGM’s during tachy and during sinus rhythm (either onset or post termination)

Clues - rates

- Ventricular rate > 240 bpm – most likely VT
- If atrial rate < Ventricular rate – most likely VT
- If atrial rate = Ventricular rate – could be VT, Sinus Tachycardia, SVT
- If atrial rate > Ventricular rate – most likely AF/AT
- Remember that two rhythms could be present concurrently (unlikely – NASPE)

Clues –RR Intervals

- Stable – could be VT, Sinus Tachy, SVT
- Sudden onset – most likely VT or SVT
  - Starts in Atrium – SVT
  - Starts in ventricle – VT
- Gradual onset – Sinus Tachycardia

Clues - EGM

- Polymorphic – most likely VT
- Broad complex – most likely VT (any other, AF, ST, SVT with abberancy)
- Different during tachycardia – most likely VT (any other, AF,ST, SVT with rate related abberancy)
- Capture/fusion beat – VT (difficult to see on EGM)
- NASPE – go for the most likely

Clues - Therapy Outcomes

- Termination by ATP – Most likely VT, SVT
- Termination by cardioversion – VT, AF, SVT but not sinus tachycardia

- Remember to look at post therapy EGM morphology for comparison during tachycardia
  - Post therapy same morphology but termination seen - indicates normal His-purkinje conduction during tachycardia (unless underlying BBB)